

Breeding Peach For Narrow Leaf Width

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Abstract

Mature peach leaves are typically about 4 x 16 cm, with a width/length ratio of about 25%. A narrow leaf seedling, selected by Wayne Sherman (Univ. of Florida, Gainesville), was hybridized at USDA-Byron with adapted commercial varieties. Early generation hybrids produced small, irregular-shaped fruit. After 5 generations, current selections are approaching commercial fruit standards in size, color, firmness, and attractiveness. Narrow-leaf trees are often noticeably more open than standard trees. This leaf type may be useful in standard- or high-density plantings to enhance spray penetration, to speed drying of wet foliage to reduce disease, to improve light penetration and photosynthetic efficiency for greater fruit size and red color, and to make the fruit more visible to speed picking. Inheritance studies indicate that the narrow-leaf character is at least partially dominant and is expressed in some F₁ seedlings of crosses with wild-type parents. The exact inheritance remains unclear as the ratios obtained to date do not fit common inheritance patterns. Progeny vary in leaf width with ratios of width/length generally ranging from 10-25%. The most extreme seedling has leaves up to 28 cm long and 1 cm wide, and although it is not fruitful, it may have ornamental value.

INTRODUCTION

Peach (*Prunus persica*) leaves vary in width depending on age, shoot vigor and location within the canopy. Typical mature leaves on commercial varieties are about 4 x 16 cm, or slightly larger on vigorous shoots. Although leaves on a shoot will vary in length, the width varies proportionately so that the ratio is relatively constant regardless of the length (Fig. 1). On a seedling tree leaves are generally narrower for the first several growing seasons while the tree is in a juvenile stage. Narrow or narrow-leaf peaches (Fig. 2), characterized by a smaller leaf width/length ratio, were mentioned as far back as 1887 (Hedrick, 1917). Blake and Edgerton (1946) classified leaf width of standard leaves (15-18 cm long) as medium if the width/length ratio was 25- 30%, as for 'Elberta'. Ratios for 32 commercial varieties released from the New Jersey breeding program ranged from 22.2-27.5%. A ratio of 20-25% was classed as narrow, and less than 20%, very narrow. The only example of the latter class given was 'Sleeper', with a ratio of 18.6%. 'Sleeper' may be the same as 'Sleeper Dwarf' (Hedrick, 1917), in which case it may have had the abnormally long leaves typical of brachytic dwarfs, hence the low ratio. Narrow-leaf types were also noted by Lesley (1957) as a product of inbreeding.

The narrow-leaf tree is noticeably more open than a standard tree. Despite the tree having a somewhat weak appearance, this character may be useful in standard or high-density plantings to enhance spray penetration, speed drying of wet foliage to reduce disease, improve light penetration and photosynthetic efficiency for greater size and red color, and to make the fruit more visible, to speed picking. Narrow leaves have been shown to have a higher water use efficiency than standard leaves (Glenn et al., 2000).

MATERIALS AND METHODS

Around 1980 Wayne Sherman (University of Florida, Gainesville) selected a peach seedling with unusually narrow leaves from a group of seedling rootstocks. This

original narrow-leaf tree (Fla. WL-1) bore small, white-fleshed, poor quality fruit. Durham (1986) self-pollinated Fla. WL-1 and produced a small progeny with a ratio of 24 narrow-leafed: 18 standard-leafed. He hypothesized that the character was controlled by 2 dominant genes with homozygous recessive at either locus producing standard type. His work was not continued, and the material was discarded. We received Fla. WL-1 from Florida in 1981 and in 1983 hybridized it with adapted peach and nectarine varieties at the USDA-ARS breeding program at Byron. Initial crosses were made with 'Flavortop' nectarine. Intermediate generations were open-pollinated, followed by additional crosses to high-quality peaches such as 'Blazeprince' to increase size and color and improve shape. These improved selections were self-pollinated or backcrossed to high fruit quality parents for genetic studies. To estimate leaf width/length ratio, 1 or 2 mature leaves from mid-shoot of current season growth on each side of the tree were measured in mid-late summer. Leaves were flattened for measurement. Width was measured at the widest point; length did not include the petiole.

RESULTS AND DISCUSSION

Early generations of narrow-leaf selections produced small, irregular-shaped fruit. After 5 generations of hybridization with commercial varieties, current selections are approaching commercial fruit standards in size, color, firmness and attractiveness. The availability of improved selections will facilitate comparisons to verify the potential advantages of the narrow-leaf character.

The variation in leaf width ratio within a given shoot or tree complicates characterization of genotype when sampling a limited number of leaves per tree. Mean leaf/width ratios of individual seedlings ranged from less than 10% to over 35%. Inheritance studies indicated that the character is at least partially dominant and is expressed in some F₁ seedlings of crosses with wild-type parents. However the precise mode of inheritance remains unclear as some of the ratios do not fit common patterns, nor Durham's (1986) two dominant gene hypothesis.

In some progenies from a cross of normal x narrow-leaf about one-third of the seedlings have been normal, higher than would be expected from chance self-pollination of the normal-leaf trees. Since the presence of any self-pollinated normal seedlings in a hybrid population would skew the ratios, test crosses will be necessary using a marker such as homozygous red-leaf in the pollen parent, to confirm that both narrow and normal hybrid progeny are obtained in the F₁. If the more narrow-leaved trees represent homozygotes for the genes and the gene is dominant, all F₁ progeny should be narrow to some degree. F₁ progenies to date have shown a range of leaf ratios.

Progeny from self-pollination of narrow-leaf selection BY96P3494 produced a somewhat bi-modal pattern of segregation for leaf ratio (Fig. 3). About 188 seedlings were narrow-leaf (leaf width ratio 8-16%) compared to 127 with wider leaves (leaf width ratio 17-27%), close to 9:7 ratio. In other populations the distribution of leaf ratio was more continuous.

For a 'Loring' x BY90P3135 progeny grown in Kearneysville, size of green and mature fruit was correlated with leaf width ($r=0.56$ and $r=0.49$, respectively; data not shown). It is possible that some of the largest fruited, widest leafed seedlings were in fact self-pollinations of 'Loring'. Correlation of fruit size and leaf width was less for other open-pollinated narrow-leaf populations measured ($r=0.35$ for green and $r=0.20$ for ripe fruit), indicating that large-fruited narrow-leaf types can be selected despite the small size of the original parent material, as we have confirmed in our breeding programs.

The most extreme seedling has leaves up to 28 cm by 1 cm wide, and although it is not fruitful, it may have some ornamental value. Narrow-leaf selections have also been selected with double flowers, red leaves, weeping branches, and upright branches.

ACKNOWLEDGMENTS

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Literature Cited

- Blake, M.A. and. Edgerton, L.J. 1946. Standards for classifying peach characters. N.J. Agr. Exp. Sta. Bull. 728.
- Durham, R.E. 1986. Isozyme banding patterns and inheritance studies in peach (*Prunus persica* (L.) Batsch). Masters Thesis, Univ, Florida, Gainesville.
- Glenn, D.M., Scorza, R. and Bassett, C. 2000. Physiological and morphological traits associated with increased water use efficiency in the narrow-leaf peach. *HortScience* 35:1241-1243.
- Hedrick, U.P. 1917. The peaches of New York. N.Y. Agri. Exp. Sta. Bull. 1916, part 2. Geneva, NY.

Figures

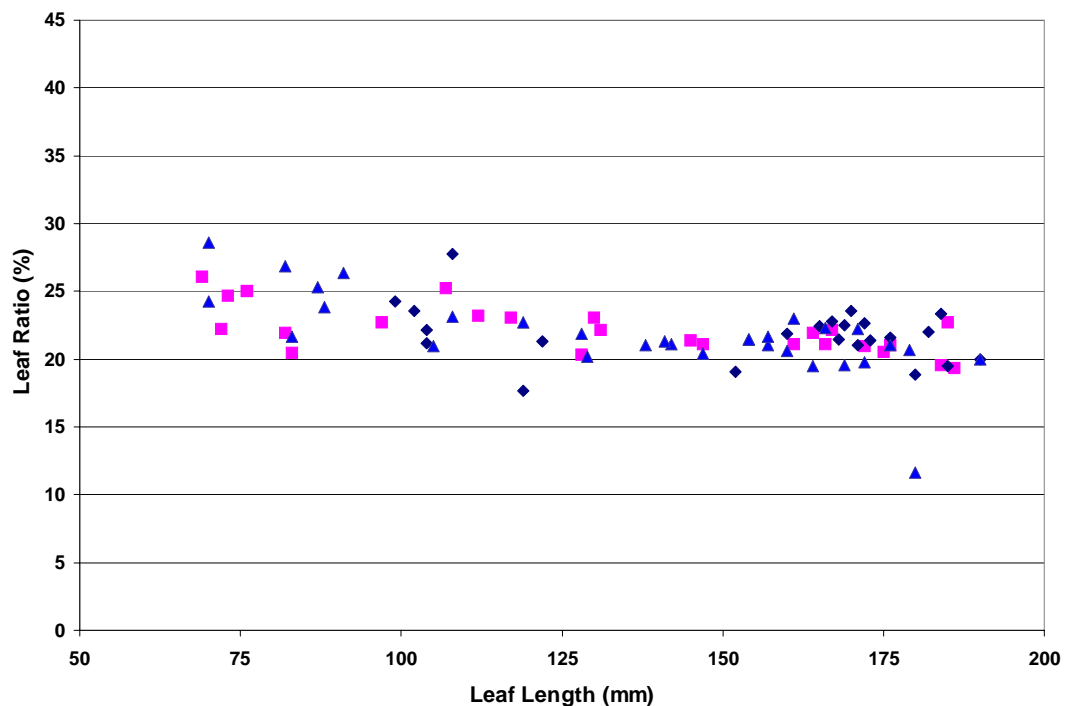


Fig. 1. Leaf ratio (width/length*100) of all mature leaves from 3 shoots of Harvester peach.



Fig. 2. Standard peach leaf compared to that of narrow-leaf selection BY92P2493. Coin diameter 19 mm.

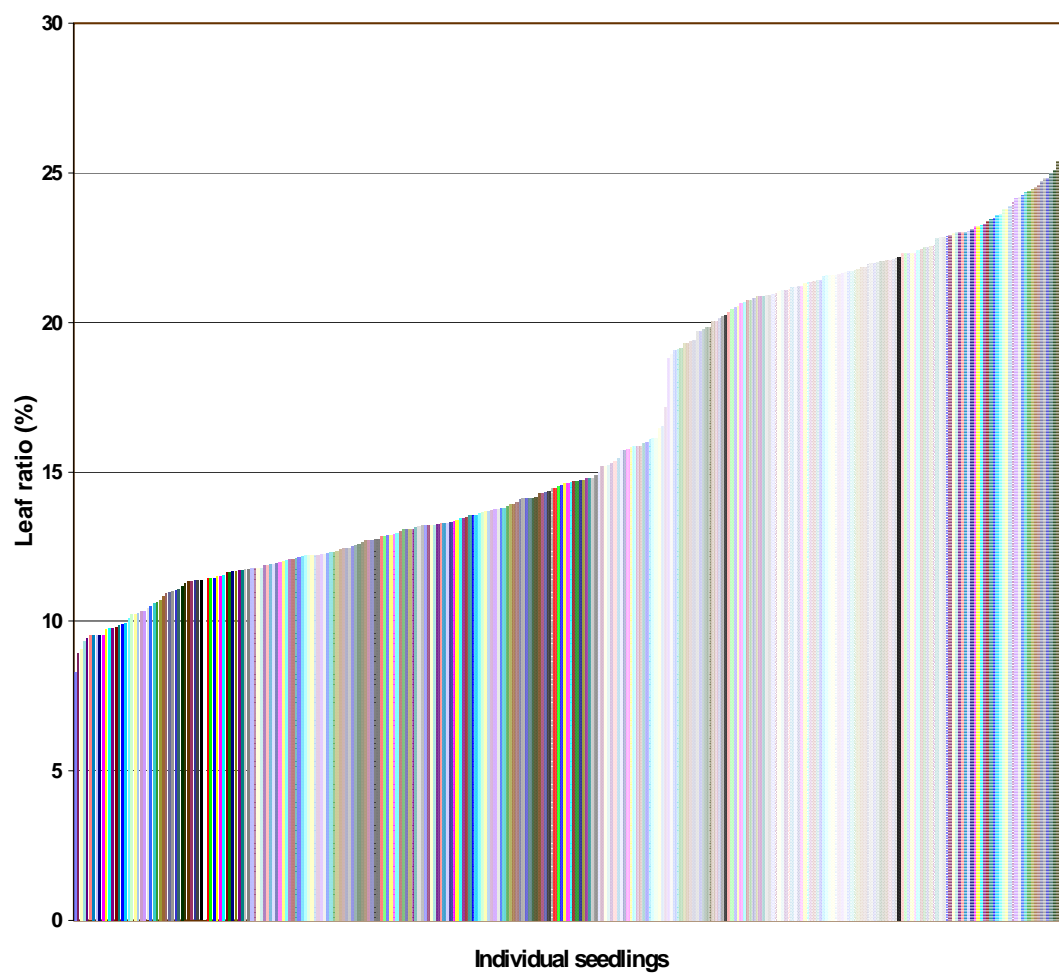


Fig. 3. Mean leaf ratios (width/length*100) of 315 individual selfed seedlings of narrow-leaf selection BY96P3494. Means of 4 leaves per tree. Narrower group has 188 trees, with 127 in the wider group.